

CSE PhD MAJOR/MINOR REQUIREMENTS

General Requirements

- (1) 10 letter graded credits are required for the major
- (2) 6 credits (at least 5 letter-graded) are required for each of the 2 minors
- (3) A student may apply one course that is counted towards the new qualification process (effective since Autumn 2022) for the major/minor requirement. However, core courses that are counted in the old qualification exam (effective before Autumn 2022) cannot be counted as major or minors.

Additional Notes

- (1) Students can take major and minors outside of the list below. They should contact a faculty member in that area prior to taking any of the classes.
- (2) Input from High-End Computing and Networking areas was not received in time for this update. However, students can still continue to major and minor in these areas - please see above.
- (3) Students could meet the requirements for the major/minors listed below using an alternative set of classes, including possibly graduate classes taken at another institution. They should contact their major/minor advisor to discuss this in ADVANCE.

TOPIC AREAS

Software Engineering and Programming Languages

Major course requirements (10 credit hours)

Required:

- a. 6341 - Foundations of Programming Languages
 - (1) Can be counted only if 6321 was used for qualification process

Electives: Choose from the following

- a. 5234 - Distributed Enterprise Computing
- b. 5235 - Applied Enterprise Architectures and Services
- c. 5236 - Mobile Software Development
- d. 5239/5349 - taught by SE&PL faculty subject to the following constraints:
 - (1) At least 3 credit-hours from courses other than 5239/5349
 - (2) At least 2 credit-hours from 5239/5349
- e. 5343 - Compiler Design and Implementation
- f. 6321 - Computability and Complexity
 - (1) Can be counted only if 6341 was used for qualification process
- g. 6333 - Distributed Algorithms

Minor course requirements (6 credit hours) Required:

- a. 6341 - Foundations of Programming Languages
 - (1) Can be counted only if 6321 was used for qualification process

Electives: Choose from the following

- a. 5234 - Distributed Enterprise Computing
- b. 5235 - Applied Enterprise Architectures and Services
- c. 5236 - Mobile Software Development

- d. 5239/5349 - Intermediate Studies in taught by SE&PL faculty
- e. 5343 - Compiler Design and Implementation
- f. 6321 -Computability and Complexity
 - (1) Can be counted only if 6341 was used for qualification process
- g. 6333 - Distributed Algorithms

Graphics

Major course requirements (10 credit hours)

Required:

- a. 5542 - Real-time Rendering
- b. 5543 - Geometric Modeling
- c. 5545 - Advanced Computer Graphics

Electives: Choose from the following

- a. 5544 - Introduction to Data Visualization
- b. 5559 - Intermediate Studies in Computer Graphics
- c. 5912 - Game Design Capstone
- d. 5913 - Computer Animation Capstone

Minor course requirements (6 credit hours)

Required:

- a. 5542 - Real-time Rendering

Electives: Choose from the following

- a. 5541 - Computer Game and Animation Techniques
- b. 5543 - Geometric Modeling
- c. 5544 - Introduction to Data Visualization
- d. 5559 - Intermediate Studies in Computer Graphics
- e. 5912 - Game Design Capstone
- f. 5913 - Computer Animation Capstone

Theory and Algorithms

Group 1:

CSE 6321 - Computability and Complexity (if not used for the qualification process)

CSE 6332 - Advanced Algorithms

CSE 6333 - Intro to Distributed Computing

CSE 5543 - Geometric Modelling

CSE 5351 - Introduction to Cryptography

CSE 5539 - Computational Geometry/Randomized algorithms and other courses offered by theory faculty

Group 2:

Math 4547, 4548 (547, 548, 549) Analysis

Math 4575 (575) Combinatorial Mathematics and Graph Theory

Math 4578 (578) Discrete Mathematical Models

Math 5051 (648, 649) Mathematical Logic

Math 5801 (655, 656, 657) Topology

Math (674) Survey of Combinatorial Mathematics
Math 6501, 6502 (775, 776, 777) Combinatorics and Graph Theory
Math 6607, 6602 (707, 708, 709) Numerical Methods in Scientific Computing
Math 6251, 6252 (722, 723, 724) Probability
ISE (702) Mathematical Programming: Linear
ISE 5200 (720) Linear Optimization
Stat 6201 (520, 521) Mathematical Statistics

Major course requirements (10 credit hours)

At least 2 courses from group 1, one of which must not be numbered 5xy9.

Minor course requirements (6 credit hours)

At least one course from group 1, not numbered 5xy9.

Software Systems

Major course requirements (10 credit hours)

Required:

- a. One of:
 - (1) 5242 – Advanced Database Management System
 - (2) 5243 - Introduction to Data Mining
- b. One of:
 - (1) 6333 – Distributed Algorithms
 - (2) 6431 – Advanced Operating Systems (if not used for the qualifying process)

Electives: Choose from the following

- a. 5241 - Introduction to Database Systems
- b. 5243 - Introduction to Data Mining
- c. 5245 - Introduction to Network Science
- d. 5249 - Intermediate Studies in Databases
- e. 5343 - Compiler Design and Implementation
- f. 5433 - Operating Systems Laboratory
- g. 5439 - Intermediate Studies in Operating Systems
- h. 5449 - Intermediate Studies in Parallel Computing
- i. 5915 - Capstone Design: Information Systems
- j. 6431 – Advanced Operating Systems (if not used for qualification process)

Minor course requirements (6 credit hours)

DATABASE Track →

Required: One or both of:

- a. 5242 - Advanced Database Management System
- b. 5243 - Introduction to Data Mining

Electives: Choose from the following

- a. 5241 - Introduction to Database Systems
- b. 5245 - Introduction to Network Science
- c. 5249 - Intermediate Studies in Databases
- d. 5915 - Capstone Design: Information Systems
- e. 6249 - Advanced Studies in Databases

DISTRIBUTED COMPUTING Track →

Required: None

Electives: Choose from the following

- a. 6333 - Distributed Algorithms
- b. 6431 - Advanced Operating Systems (if not used for qualification process)
- c. 5433 - Operating Systems Laboratory
- d. 5439 - Intermediate Studies in Operating Systems
- e. 5449 - Intermediate Studies in Parallel Computing
- f. 6439 - Advanced Studies in Operating Systems
- g. 6449 - Advanced Studies in Parallel Computing

Artificial Intelligence:

Major course requirements (10 credit hours)

Required:

- a. One of:
 - (1) 5522 - Survey of Artificial Intelligence II: Advanced Techniques
 - (2) 6521 – Artificial Intelligence
- b. One of:
 - (1) 5523 - Machine Learning and Statistical Pattern Recognition
 - (2) 5526 - Introduction to Neural Networks

Electives: Choose from the following

- a. 5524 - Computer Vision for Human-Computer Interaction
- b. 5525 - Foundations of Speech and Language Processing
- c. Including up to one 5539 - Intermediate Studies in Artificial Intelligence

Minor course requirements (6 credit hours)

Required:

- a. One of:
 - (1) 5521 - Survey of Artificial Intelligence I: Basic Techniques
 - (2) 5522 - Survey of Artificial Intelligence II: Advanced Techniques
 - (3) 6521 – Artificial Intelligence

Electives: Choose from any other graded AI courses including up to one 5539

Security and Privacy

Major course requirements (10 credit hours)

Required:

- a. 5471 Introduction to Cybersecurity
- b. One of:
 - (1) 5473 – Network Security
 - (2) 5474 – Software Security

Electives: Choose from the following

- a. 5351 – Introduction to Cryptography
- b. 5359 – Intermediate Studies in Cryptography
- c. 5472 – Information Security Projects
- d. 5477.01 – Offensive Security
- e. 5477.02 – Malware Analysis and Reverse Engineering
- f. 5479 – Intermediate Studies in Computer Security
- g. 5194.01 – Digital Forensics

Minor course requirements (6 credit hours)

Required:

- a. None

Electives: Choose from the following

- a. 5351 – Introduction to Cryptography
- b. 5359 – Intermediate Studies in Cryptography
- c. 5471 – Introduction to Cybersecurity
- d. 5473 – Network Security
- e. 5474 – Software Security
- f. 5477.01– Offensive Security
- g. 5477.02– Malware Analysis and Reverse Engineering
- h. 5472—Information Security Projects
- i. 5194.01 – Digital Forensics